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Technical Research Note 224

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**ABSTRACTS OF  
BESRL RESEARCH PUBLICATIONS -- FY 1970**

Emma E. Brown

OFFICE OF THE DIRECTOR

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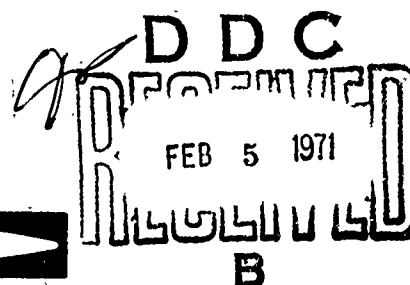


**U. S. Army**

**Behavior and Systems Research Laboratory**

**October 1970**

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**ABSTRACTS OF  
BESRL RESEARCH PUBLICATIONS -- FY 1970**

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October 1970

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Personnel Management Research--Selection  
Personnel Management Research--Manpower Management  
Human Performance Experimentation  
Manned Systems Research

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# BEHAVIOR AND SYSTEMS RESEARCH LABORATORY

An activity of the Chief, Research and Development

J. E. UHLANER  
Director

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**NOTE:** The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

## FOREWORD

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The present Technical Research Note continues the series of abstracts which began with Fiscal Year 1957. The series provides a synopsis of research efforts which reach either final or interim reporting stage during each fiscal year.

A substantial portion of the end-products of BESRL's research takes the form of psychological testing instruments to aid in the selection, classification, and utilization of Army personnel. About 30 Army personnel programs make operational use of over 100 research test products. Estimates of the number of personnel tested in the various programs during FY 1970 appear as the final section of this publication.

Simulation models developed by BESRL through operations research modeling assist Army personnel management in evaluating and deciding upon policies for the selection, allocation, training, and career progression of officers and enlisted men, as well as in planning future manpower policy. Through computerized programs, models are applied in the solution of Army personnel management problems. The products are increased knowledge of the effect of procurement, distribution, training, and reassignment policies on manpower quality, and comparison findings on alternative policies.

BESRL's human performance experimentation yields findings bearing on behavioral functions common to a number of Army systems. Typical products are improved operating procedures, work methods, and supervisory practices which enhance the performance of individuals within the system.

Manned systems research as conducted by BESRL has as its principal objective the enhancement of total system effectiveness through research on human performance. Scientific findings on human capabilities and performance under varying conditions within the system--findings which have implications for systems design, development, and use--constitute the end-products.



J. E. UHLANER, Director  
U. S. Army Behavior and Systems  
Research Laboratory

ABSTRACTS OF BESRL RESEARCH PUBLICATIONS --  
FY 1970

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# INTRODUCTION

## BESRL RESEARCH PUBLICATIONS

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### TECHNICAL RESEARCH REPORTS

BESRL Technical Research Reports are publications describing completed research projects or programs which contribute directly to the solution of Army human factors problems in the broad areas of personnel management and the enhancement of human performance both individual and in the Army's manned systems. The Report is generally divided into two parts-- a brief general report to management and a technical supplement.

### TECHNICAL RESEARCH NOTES

BESRL Technical Research Notes are of interest primarily to technically trained research workers in the Department of Defense and in other government research agencies. The Research Notes present technical information concerning research methodology or basic psychological and operations research knowledge growing out of the work program.

### RESEARCH STUDIES

The Research Studies are special reports to military management, generally prepared in response to questions raised by operating agencies when early answers are needed. Research Studies may include presentations to military management, interim bases for changes in personnel operations, and bases for research decisions. Distribution is usually limited to operating agencies with a direct interest in the content.

With the last Research Study of FY 1970, this publication series was discontinued. A new series, Research Problem Reviews, was initiated and will appear in the Abstracts for FY 1971.

### RESEARCH MEMORANDUMS

BESRL Research Memorandums are informal reports on technical research problems. Research Memorandums include the following types of content: details concerning construction of experimental instruments, fragmentary or incidental data, and methodological developments relating primarily to in-house technical operations. Limited distribution is made, primarily to personnel engaged in research for the U. S. Army Behavior and Systems Research Laboratory.

## FY 1970 ABSTRACTS

Abstracts have been prepared for the majority of FY 1970 publications of the U. S. Army Behavior and Systems Research Laboratory. Where a publication has been abstracted, the principal research findings have been described as much as possible in non-technical language. Technical language has generally been used as the most expeditious method of communicating details of research and analysis.

BESRL research publications are numbered consecutively and continuously from year to year, in separate series, for the four types of publication. Publications released during FY 1970 include Reports 1158 through 1164, Notes 211 through 223, Research Studies 69-11 and 70-1 through 70-5, and Research Memorandums 69-1 and 70-1 through 70-3. Research Note 224 identifies by publication serial number all research publications prepared and released by the U. S. Army Behavior and Systems Research Laboratory in FY 1970. The listing includes 7 Technical Research Reports, 13 Technical Research Notes, 6 Research Studies, and 4 Research Memorandums.

Included are descriptions of 19 Work Units covering activities reported in the 30 abstracted publications, followed by the number of the abstracts of publications under each Work Unit. Included also are a list of the libraries in universities and metropolitan centers in which these publications are routinely deposited, and a listing of the U. S. Army personnel programs utilizing psychological test programs of the U. S. Army Behavior and Systems Research Laboratory.

## DISTRIBUTION OF BESRL PUBLICATIONS

Initial distribution of each Technical Research Report and Technical Research Note is made directly by the U. S. Army Behavior and Systems Research Laboratory. Research Reports are distributed primarily to operational and research facilities and their sponsors in the Department of Defense, to other interested governmental agencies, and to the Library of Congress which in turn distributes to depository libraries. Research Notes are distributed primarily to technically trained research workers, including those reached through Library of Congress channels.

Qualified requestors may obtain copies of Technical Research Reports and Technical Research Notes directly from the Defense Documentation Center. Copies may be purchased from the Clearinghouse for Federal Scientific and Technical Information, Department of Commerce, Springfield, Virginia 22151. In the case of Technical Research Reports and Technical Research Notes, the AD number, when available, has been added for convenience in requesting copies from the Defense Documentation Center or from the Clearinghouse for Federal Scientific and Technical Information.

Copies may also be obtained on loan from depository libraries in many metropolitan and university centers. A list of these libraries appears on Pages 36 through 43.

Research Studies and Research Memorandums are not available for general distribution.

Operational tests are for official use only.

## ABSTRACTS

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### BESRL Research Publications -- FY 1970

#### TECHNICAL RESEARCH REPORTS

1. TRR 1158. Seymour Ringel, James D. Baker, Michael H. Strub, and Loren L. Kensinger.  
Human factors research in command information processing systems--Summary of recent studies.  
July 1969. AD 694 347

The report provides a synopsis of BESRL's research program in tactical information processing and decision making. Emphasis is on accomplishments and research undertaken from March 1966 through mid-1969. Research completed prior to 1966 was summarized in BESRL Technical Research Report 1145, Human factors research in command information processing systems, March 1966.

BESRL's manned systems research in this area is directed to the enhancement of human performance and facilitation of man-machine interaction through experimentation with various configurations of system components. The end-products are scientific findings on human capabilities and performance under varying conditions within the system. Findings having implications for systems design, development, and operational use are presented in abbreviated form accompanied by sufficient information on a given experiment to indicate the basis for the findings reported.

During a major portion of the 1967-69 period, a BESRL unit, the Command Systems Field Branch, was located with the Seventh Army TOS Development Group in USAREUR to perform research in an operational setting and to furnish human factors assistance to TOS evaluation efforts--including problems of data display, information assimilation, decision making, data input, message composition, and information requirements of the system.

Through FY 1970, the research program was divided between two Work Units. Included in the Tactical Information Processing Work Unit were research efforts focusing on the rapid and accurate input and assimilation of information--screening incoming data, selecting appropriate format, and translating data for input, and the decision making process as affected by conditions of the system environment (amount of information or feedback, for example). The Tactical Operations Systems Work Unit has sought to maximize the effectiveness of command information processing systems, emphasizing aspects of the total system such as allocation of functions to man and equipment. Concern is with processes which intervene between the commander's acquisition of a mission and his issuing of orders--aggregation of information of varying accuracy and reliability as a basis for action, evaluation of conflicting items of information, recognition of patterns of activity represented by a sequence of items, interactions between a man's confidence in his ability to evaluate information and his performance in information assimilation.



2. TRR 1159. Milton H. Maier and Edmund F. Fuchs. Development of improved aptitude area composites for enlisted classification. September 1969. AD 701 134

During the past ten years, Army equipment has become more complex, and training courses have changed to meet correspondingly more complex job requirements. Some Army schools have accordingly asked for more comprehensive measures of trainability as a basis for school assignment. In response, BESRL has recently completed a long-term research program to determine how the Army Classification Battery test scores could be combined to provide better measures of trainability for the modernized courses.

Operational test scores were obtained for 25,000 men in over 100 different Military Occupational Specialties (MOS). The men were followed through training, and their course grades served as criteria to determine how well the tests measure potential for training in each area. Based on the validity coefficients obtained, new aptitude area composites were developed through test selection methods. Simulated allocation procedures were applied to find how much the new composites would improve classification for training and jobs.

The resulting eight aptitude areas can provide improved measures of trainability. The composites are each based on three or more tests, thus making greater use of information already available from the ACB tests and permitting greater differentiation in assignment--this, despite the fact that tests of general ability are more heavily weighted than in the two-test composites. Benefits would be about a 20 percent reduction in the number of training failures and about a 10 percent improvement in the training performance of the men who complete training successfully.

3. TRR 1160. A. H. Birnbaum, Robert Sadacca, R. S. Andrews, and M. A. Narva. Summary of BESRL surveillance research. September 1969. AD 701 907

The SURVEILLANCE SYSTEMS research program of the Behavior and Systems Research Laboratory has as its objective the production of scientific data bearing on the extraction of information from surveillance displays and the efficient storage, retrieval, and transmission of this information within an advanced computerized image interpretation facility. Findings are applicable in optimizing human component performance in existing systems and in providing systems developers with information useful in design specifications for future systems.

The present report summarizes in integrated fashion the rationale, broad objectives, and specific projects of the research program and delineates the major areas in which BESRL's manned systems experimentation has resulted in findings of interest to the Office, Chief of Research and Development, the Assistant Chief of Staff for Intelligence, the Assistant Chief of Staff for Force Development, and the U. S. Continental Army Command.

Research completed or in progress is grouped in three categories:

- 1) research concerned primarily with specific tasks and functions,
- 2) experimentation concerned with display requirements for accomplishing actual or conceptualized tasks, and 3) that requiring a systems context for execution because of concern with the totality of system performance as well as with the separate and interactive contributions of the various subsystems and elements.

Equipment and capabilities of BESRL's Information Systems Laboratory are described, as well as the systems measurement bed which provides a highly flexible controlled environment for human performance experimentation and evaluation ranging from that of individual interpreters and associated equipment and methodological aids to that of a total computerized information processing system.

4. TRR 1161. Abram G. Bayroff and Edmund F. Fuchs. The Armed Services Vocational Aptitude Battery. February 1970. AD 706 832

The Assistant Secretary of Defense (Manpower and Reserve Affairs) requested research on a common aptitude battery that could be used by all the services. The Army with BESRL as its research agency has been the lead service in an accelerated program to determine to what extent corresponding aptitude tests of the several services are interchangeable, and to develop shortened forms of appropriate tests to constitute a battery for service-wide use. The battery was also to provide measures comparable to the four content areas of the Armed Forces Qualification Test.

Comparability of the tests in the batteries used by the several services was determined from test intercorrelations in a consolidated sample of enlisted input (1000 each from the Army, the Navy, and the Air Force, and 300 from the Marine Corps). The sample was stratified on AFQT to provide a mobilization distribution. Correlation coefficients were corrected first for restriction in range on AFQT and then for unreliability (test-retest with alternate forms).

Seven pairs of tests were identified as interchangeable: word knowledge, arithmetic reasoning, space perception, mechanical comprehension, shop information, automotive information, and electronics information. The Army Coding Speed Test was selected as a measure of clerical aptitude on the basis of separate validity studies. Tool Knowledge, an eighth test, was added to provide a score comparable to the fourth score on the AFQT.

The new battery (the Armed Services Vocational Aptitude Battery, ASVAB) was standardized on a 3000-man sample of Selective Service registrants, again stratified on AFQT. Raw scores were converted to percentiles of the mobilization population. Patterns of relationships among ASVAB tests and of ASVAB tests with AFQT were similar to those of the parent tests.

The ASVAB is currently used to provide counseling information and to test potential recruits in the last year of high school.

5. TRR 1162. Robert L. McMullen. SIMPO-I Career-Noncareer Model. May 1970.

In response to an operations research requirement established under the sponsorship of the SIMPO-I Monitor Committee, BESRL has been engaged in research and evaluation of the Army's personnel subsystem with respect to effectiveness of policies in assignment, training, utilization, and contingency readiness of specialized personnel. The SIMPO-I effort was directed to development of a model simulation package for assessing quantitatively the cumulative impact of personnel policy changes on the allocation, distribution, and utilization of Army personnel with special attention to effects of policies on deployability.

An earlier publication (BESRL Technical Research Report 1157) reported on progress in planning and production of computerized models for use in dealing with the manpower system problems noted above and evaluating alternative personnel policies. The present publication deals with the development and user application phases of a model of the career and noncareer segments of the Army personnel system. The Career-Noncareer Model (a specialized mass-flow model) is a versatile model of the short tour and sustaining base areas that can be used to evaluate policies on training input, reassignment, manning levels, or utilization of manpower. The model can provide a dynamic picture of a given set of alternative force structures to deal with actual or hypothetical military requirements and the extent to which each force structure is feasible under given policies and system constraints. The model may also be used for evaluating the sensitivity of the system to various force structure parameters. For example, changes in type or quality of input might affect the feasibility of various requirement configurations.

The Career-Noncareer Model makes efficient use of computer time (typically, about three minutes on the present BESRL computer for a 48-month projection). Many user options are available, and adaptation to many subsystems is easily accomplished. The publication describes the systems simulated and the model logic. Instructions for model use, a listing of computer programs for the model and explanations of the logic, and example applications are provided.

6. TRR 1163. Jack J. Sternberg and James H. Banks. Search effectiveness with passive night vision devices. June 1970.

BESRL's night operations research program deals with problems in optimizing human performance in relation to night vision devices and related sensors. A field unit has been established at Fort Ord, California, where with the support of the Combat Developments Command and the Combat Developments Command Experimentation Command, research is currently being conducted with the immediate objective of enhancing the capabilities of the combat soldier in night operations.

TRR 1163 describes the research methodology used and reports on the first of a series of experiments directed toward identifying factors which affect performance with passive night vision devices and developing means of improving performance effectiveness.

Performance with four devices was evaluated in the experimental procedures: the Miniscope (MINI), Starlight Scope (SS), Crew-Served Weapon Night Vision Sight (CSWS), and the Night Observation Device, Medium Range (NOD). At a rate of nine per night, 123 soldier operators were tested, under three ambient illumination levels, in the search and detection of 72 targets. Targets differed in type, contrast, and mode, and were stationed at distances of 100 to 1200 meters. Detection responses and search behavior were recorded on magnetic tape for subsequent data analysis. Operators differed greatly in target detection ability during search, and reliability in detecting specific targets was low. Relatively long periods (at least six hours) of almost continuous use of the devices were maintained without performance degradation. Performance with the NOD was superior to that with other devices. Pairs of operators both using devices of the same type detected about 50% more targets than did single operators. Performance was significantly affected by a number of environmental-target-terrain factors including ambient light, distance, target type, and target-background contrast. Faulty search techniques were determined to be the primary cause of inefficient performance. Effective training procedures and a technique by which operators were able to make proper eyepiece diopter adjustment of their devices were developed. The latter development in effect eliminated the eyestrain which had frequently led to headache and nausea with consequent degradation of performance.

The field experimentation methodology and instrumentation developed are applicable to a wide range of field research on problems of performance with night vision devices and sensors.

7. TRR 1164. John P. Farrell, James H. Banks, and Jack J. Sternberg. Search effectiveness with the Starlight Scope and 7 x 50 binoculars. June 1970.

The experiment reported was the initial research conducted by BESRL in the area of night operations. It represented a preliminary effort to identify critical factors affecting performance and to develop methodology and instrumentation essential to scientific field experimentation in search effectiveness in night operations. With the support of the Army Infantry School at Fort Benning, Georgia, BESRL research personnel tested the performance of 65 soldier operators using two different night seeing devices. Subsequent research by the BESRL field unit with the support of the Combat Developments Command Experimentation Command at Fort Ord, California is described in TRR 1163 (6, above).

At Fort Benning, four men were tested nightly, three using the Starlight Scope, and one using the 7 x 50 binoculars. Testing was conducted under starlight, half-moon, and full-moon conditions. The 48 targets presented were either soldiers or foam rubber "aggressor" type silhouettes, in moving and stationary mode, respectively. Operators were told that they were on perimeter defense and that it was their responsibility to detect and shoot all enemy targets in their search sector. The search area was rectangular in shape, 400 meters long and 200 meters wide. Target detection responses were recorded electronically. The data were analyzed to determine performance effectiveness with the two devices, as well as the effect of critical variables on performance.

The Starlight Scope was superior under all conditions and effected significant improvement in target detection ability. The binoculars were reasonably effective under high illumination (full moon), particularly at short distances (less than 200 meters); with lengthy target exposure their effectiveness approached that with the Starlight Scope. Detection performance with the Starlight Scope, however, was differentially affected by several of the variables studied. Under the favorable conditions noted, binoculars could be used with some confidence in surveillance activities; under starlight conditions, their value would be limited.

The experiment provided baseline data on performance with the two instruments, as well as identification of factors critically affecting performance and information about the effects to be expected.

#### TECHNICAL RESEARCH NOTES

8. TRN 211. Thomas E. Jeffrey. Effects of information requirements, timing procedures, and photo scale on interpreter performance. July 1969. AD 693 260

An experiment was conducted to determine how the screening of real-time imagery for frames containing priority targets and the immediate identification of targets are affected by variations in the complexity of the task, timing procedures, and photo scale.

School-trained image interpreters ( $N = 32$ ) screened imagery to select frames containing priority targets, at the same time detecting and identifying the targets. Half the interpreters were to identify priority targets exclusively; the other half were to identify priority targets and also to annotate any nonpriority military objects detected while searching for priority targets. Another division of the interpreter sample was made for photo scale, half working with imagery at 1:3300, half at imagery at 1:2200. Half were mechanically paced through the missions, half paced themselves under a total time limit. Experimental conditions were allotted according to a  $2^3$  factorial research design. Performance on both screening and target identification was evaluated for completeness and accuracy.

Interpreters searching exclusively for priority targets achieved more complete selection of priority target frames and priority target identification but were less accurate in both aspects of the task than those providing additional annotations. Interpreters mechanically paced through the missions were less accurate, but no less complete in identifying priority targets than those under a total time limit. In screening, timing procedures produced no significant differences. Interpreters required to annotate objects other than priority targets annotated on the average 37 percent of the non-priority targets in the time allotted. Identifications were 83 percent correct.

Scale variation had no effect on the completeness or accuracy with which interpreters selected target frames or identified priority targets. It was concluded that, for the conditions typified by the experiment, photo scales in excess of 1:3300 produce no significant improvement of interpreter performance.

9. TRN 212. James D. Baker (BESRL) and Douglas J. Mace and James M. McKendry (HRB-Singer Inc.). The transform operation in TOS: Assessment of the human component, August 1969. AD 697 716

The experimental version of the automated Tactical Operations System (TOS) utilizes over 40 different message formats. At the present stage of TOS development, G3 staff action officers have to determine which message format or formats to use with each set of incoming data. The present study was conducted by BESRL's Command Systems Field Branch in Europe to examine systematically the human factors problems related to error rate, processing time, and confidence in format selection. A second objective was to evaluate a newly devised job aid for use in selecting the appropriate formats.

Forty-seven simple messages were given to 14 individuals familiar with TOS or G3 operations, or both. Their task was to select an appropriate format for each message. Half the men used a simple job aid devised by the experimenters, the other half used a "menu" type listing of available formats. The time taken to complete the entire task was recorded. Individuals also rated the degree of confidence they had that the proper format had been selected.

A mean time of approximately 50 seconds was taken for message reading and format selection. Average error rate in format selection was 22 percent. No significant difference was noted in performance with the job aid over that with the "menu" type listing. Messages of different types and subject matter differed in error rate of format selection. Mean confidence in format selection was almost the same for both groups.

10. TRN 213. J. Richard Lepkowski (System Development Corporation). Study of near real-time screening performance. I; Scale, resolution, and presentation rate. August 1969. AD 698 455

An experiment on rapid screening performance with transmitted imagery differing in scale, resolution (quality), and rate of presentation was conducted jointly by personnel of the System Development Corporation and the Behavior and Systems Research Laboratory. The operational objective was to find what degrees of screening thoroughness and accuracy can be expected for imagery of varying quality under different conditions. Examinees participating in the experiment were 96 recent enlisted graduates of the U. S. Army Intelligence School at Fort Holabird. Two examinees were randomly assigned to each of 48 experimental combinations to be tested.

Dependent variables were: scale (1:2000 and 1:4000), optical resolution (4 levels), and film movement rate (6 levels: 6, 4, 2, 1.5, 1, and .8 seconds per 70 mm frame). Resolution was systematically degraded to simulate transmitted imagery using a range of radio bandwidths. Rates of presentation simulated film processor output rates. Examinees tagged each of 100 frames as containing targets (wheeled or tracked vehicles) or no targets. Responses were made by activating a three-position switch connected to a polygraph event recorder. The hard copy record of each examinee's responses was scored for screening thoroughness and accuracy.

Screening accuracy was significantly poorer with reduced scale, lower resolution, and faster presentation rate. Screening thoroughness was high (.98 to 1.00), except at the fastest rate (.8 second per frame) which yielded a significantly lower score (.93). In general, poorer quality imagery can be used if more time is allowed for screening and if scale is sufficiently large. The considerable gain in overall screening efficiency through viewing large ground areas quickly achievable with small-scale imagery and rapid presentation can be attained only with higher quality imagery.

11. TRN 214. Michael G. Samet. Checker confidence statements as affected by performance of initial image interpreter. September 1969. AD 700 127

With the advent of computer-aided intelligence systems, emphasis on techniques for processing probabilistic information has grown. The present publication reports on one aspect of assigning interpreters to work as two-man teams in which one interpreter checks interpretations made independently by his teammate. Specific concern was to determine how different levels of identification accuracy and of confidence validity associated with an initial interpreter affect the confidence validity of the checker. Of secondary interest was whether checkers supplied with some knowledge of their own prior identification and confidence performance would be affected differently.

Identifications of 60 annotated targets and associated confidence statements were obtained from 18 newly trained image interpreters. Confidence was stated under a point payoff scheme in which it was to the disadvantage of the interpreter to overstate or understate his confidence. Half the interpreters were given individual performance feedback. Interpreters were then presented with three sets of 60 annotated images to which identifications and confidence statements attributed to an initial checker were attached. The information provided incorporated three levels of identification accuracy and three levels of confidence validity, arranged in a Graeco-Latin square research design. The task of the interpreter was to examine each annotation, note the previous identification and confidence statement, and then state his own confidence in the identification.

Interpreters' confidence statements were more valid when they were checking than when they were stating confidence in their own identifications. Checkers' confidence statements were more affected by observed variations in the identification accuracy of the initial interpreter than by his confidence validity. Knowledge of their own initial identification and confidence proficiency did not affect checker performance.

Checkers typically improved on the confidence validity of interpreters who were poor or only moderately good in stating confidence. Checker confidence statements in identifications made by interpreters with an excellent record of confidence validity were less valid than those of initial interpreters. Thus, in team operations, confidence statements made by initial interpreters who have excellent records of estimating

the probability that their identifications are correct should be allowed to stand. The checkers' confidence statements are to be preferred when initial statements are supplied by interpreters whose past performance in making such statements is poor or only moderately good.

12. TRN 215. Frederick W. Kuehl. Evaluation of a multiplicative generator of pseudo-random numbers. September 1969. AD 707 374

SIMPO-I entity models make extensive use of random numbers. Personnel in the Army have been simulated, for example, by using a sequence of eleven random numbers to develop representative test scores on the eleven tests of the Army Classification Battery. The scores can be given desired distributions and interrelationship by appropriate transformation, a characteristic particularly important when a policy change affecting these aspects of the sample is being evaluated.

Mathematical games of strategy are another important application. In such an application, a model of the system is developed which includes significant variables and appropriate interactions. By varying the relative weights and interactions, the behavior of the system under various strategies and policies is simulated and the system is evaluated by noting the effect on criterion measures. Random numbers are used to represent the different variables.

The generator available when the present effort was undertaken used a power residue or multiplicative method in a single computer word of 24 bits. Statistical tests made on samples of numbers generated by this program indicated that the samples had unacceptable properties. Because of the results of these tests and also because of theoretical considerations favoring a generator based on a longer word length, decision was made to develop a generator which uses double precision arithmetic (48-bit computer words).

The pseudo-random number generator developed and tested is capable of rapidly supplying the SIMPO-I entity models with numbers meeting essential tests for random qualities. Repeated multiplication of a starting number by a carefully chosen constant produced a series of 47-bit binary numbers which were reduced by the modulus of the system ( $2^{47}$ ), (the 48th bit is a sign bit). To increase randomness, the 12 low order bits were not used. The resulting numbers were converted to base 10 and assigned a decimal point to the left of the first digit. Tests were made on groups of 10 numbers to evaluate their conformation to expected distributions.

In addition to an acceptable generator, the effort has resulted in a compilation of statistical tests which have wider application for evaluating generators used in other computer systems. The tests are described and essential mathematical formulations are presented.

The multiplicative generator of pseudo-random numbers developed is in use in the BESRL computer installation.



13. TRN 216. Carrie W. Waters. Comparison of computer-simulated conventional and branching tests. March 1970. AD 707 375

As one avenue to the development of more effective input screening techniques, the feasibility of programmed testing is being investigated. BESRL has conducted several experimental and theoretical studies of branching tests (See TRN 129, 140, and 188). Such tests permit greater individuation of testing than do conventional tests. In the usual testing situation, each examinee takes all the items, and item sequence is the same for all examinees. In branching tests, items are so programmed that an examinee who answers a test item correctly is presented next with a more difficult item, and an examinee who does not answer correctly is presented with an easier item. The rationale for the branching procedure is that, by basing presentation of items on an examinee's past performance, each person takes items that are progressively more appropriate to his own level of ability. It is conceivable that such a procedure would reduce testing time and for a given amount of time would permit more accurate measurement, principally by reducing opportunities for chance success when individuals attempt items too difficult for them.

The present publication reports on a comparison of computer-simulated branching and conventional tests which varied in length, distribution of item difficulty, and item validity. Comparison was in terms of correlation between underlying ability and test scores (Lord's model). The model assumes that there is a trait or ability underlying the raw scores on a test and that the probability of an examinee's responding correctly to a test is a normal ogive function of his position on the ability dimension.

The principal finding was that in tests with higher item validity ( $r_{bis} = .60 - .90$ ), a branching test had higher correlation with underlying ability than did any of the conventional tests, for all three lengths studied.

14. TRN 217. Emma E. Brown. Abstracts of BESRL research publications--FY 1969. September 1969. AD 700 128

Research publications prepared and released by BESRL in FY 1969 are identified both by publication serial number and AD number. Included are two Technical Research Reports, twelve Technical Research Notes, thirteen Research Studies, and six Research Memorandums. Work Units included in BESRL's Work Program for FY 1969 are briefly described and references to relevant abstracts are noted by number. Provided also are a list of depository libraries furnished copies of BESRL Technical Research Reports and Technical Research Notes and a compendium of information on BESRL test products that are operational in the Army's personnel selection and classification programs.

15. TRN 218. Jerrold M. Levine and J. Bennett Feallock (North American Rockwell) and Robert Sadacca and Robert Andrews (BESRL). Method for quantifying subjective costs of large numbers of image interpretation errors. November 1969. AD 704 706

A practicable and rapid method was developed for quantifying the subjective costs that unit commanders attach to the consequences of decisions made on the basis of erroneous image interpretation reports. By measuring subjective costs, it becomes possible to take into account both tangible and intangible losses in a way that would not be possible with standard objective measures. Such values can be used to specify with greater precision the intelligence requirements of individual commanders performing particular missions. At the simplest level, interpreter reports could be weighted by their probability of error, which, when combined with the estimated cost of such error, would provide an index by which the value of each report could be judged. These values could then be used to control accuracy/completeness tradeoffs in interpretation. They could also serve as guidelines to intelligence and other staff officers on the consequences of action based on different types of erroneous information and could help specify appropriate imagery "take" parameters for reconnaissance aircraft.

In developing the method, a hierarchical target classification and reporting scheme was constructed which defined approximately 3,300 interpretation errors. Magnitude estimation was chosen as the only feasible technique for establishing an interval scale of costs for so large a number of errors. Costs for several hundred selected errors were measured directly, based on the judgment of field grade combat officers, and costs of the remaining errors were predicted from the obtained costs using a multiple regression equation. The validity of the cost scale was determined by comparing it with cost scales resulting from two more sophisticated and detailed scaling procedures which, though more time-consuming, required less complex judgments.

The scale of costs determined by direct magnitude estimation had mean validity coefficients of .67 and .73 based on the two criterion scales, and mean reliability of .80. The magnitude estimation scale was sensitive to differences in the military situation--defensive versus offense--for which the aerial surveillance information was required.

16. TRN 219. John T. Cockrell (System Development Corporation). Maintaining target detection proficiency through team consensus feedback. December 1969. AD 707 736

A series of experiments, monitored by the Behavior and Systems Research Laboratory, is conducted in an effort to develop team consensus feedback procedures which will lead to enhancement of performance of individual interpreters. An exploratory study in the series, reported on in BESRL Technical Research Note 195, Maintaining image interpreter proficiency through team consensus feedback, supported the usefulness of the process as an aid to proficiency maintenance for interpreters in an image interpretation facility. The present publication reports on further work in the area, with emphasis on target detection skill.

Specifically, the present experiment was designed to determine if the target detection skill of individual interpreters can be improved by feedback which team members generate for themselves as they compare and discuss their work. This experiment differed from the preceding in that target detection only was required, rather than detection plus identification. In addition, the experimenter investigated the impact on individual interpreter performance of 1) size of team (3-man versus 2-man); 2) discussion versus no discussion; 3) initial proficiency level of team members; and 4) team composition (heterogeneous versus homogeneous) with respect to initial proficiency level. Sixty U. S. Army Intelligence School graduates participated in the experiment. Treatment was a three-day practice session. A pre- and post-treatment test was administered to each interpreter to assess detection proficiency. Interpreters assigned to feedback conditions practiced in teams and were permitted either to discuss or compare their work; the no-feedback interpreters practiced alone and were not permitted to discuss or compare their work with anyone. Neither group received ground truth feedback.

As in the previous experiment, interpreters working in teams with consensus feedback showed greater improvement in reducing inventive errors than did interpreters working alone. There was no difference, however, in errors of omission. No difference was observed between discussion versus no-discussion or between three-man versus two-man teams, but interpreters in heterogeneous teams showed significantly greater gain in performance on all measures than interpreters in homogeneous teams. Relatively greater improvement was noted in the performance of team members who were initially low in proficiency than those who were initially high.

From both experiments conducted to date, evidence points to the effectiveness of team consensus feedback in maintaining and enhancing performance of interpreters in field units, particularly in target identification and reduction of inventive errors. The technique appears to be especially useful where ground truth is not available.

17. TRN 220. Thomas E. Jeffrey. Unaided reading of coded reconnaissance data. December 1969.  
AD 707 377

In reconnaissance imagery as currently acquired, sensor data and other pertinent information usually appear in coded form on the imagery. The obvious intention is to have the coded data read by machine. Since few reading machines are as yet available, however, interpreters are likely to be called upon to read the encoded data directly. Even when readers become available, interpreters working away from an automated facility will have to read the code matrix directly. The present experiment dealt with the feasibility of having interpreters decipher sensor and terrain information by direct inspection of the imagery.

Code deciphering ability was evaluated by having school-trained image interpreters read portions of 15 different code matrix blocks on which reconnaissance information was encoded. Interpreters were trained to recognize the spatial patterns of dots representing the information to the point of two error-free performances. Three five-man groups decoded three sets of five blocks, each set under a different level of magnification. Magnification order varied among groups so that all sets were decoded at all three levels of magnification. In the experiment proper, time required to locate the required block and decode the data and number of correct decodings constituted the data for analysis.

The average interpreter was 98% accurate in translation from code to clear language. Direct inspection (unaided eye) was not significantly aided by magnification. Use of seven-power magnification reduced decoding time over two-power magnification. Practice significantly reduced decoding time, but accuracy was not affected. These findings suggest procedures for interpreter practice and improvement in recognizing the spatial patterns in which data are encoded. Flash cards are being prepared for use in self-training in the task. In addition, equipping the seven-power magnifier now issued image interpreters with a reticle designed to aid in defining the data fields would be useful.

18. TRN 221. Michael H. Strub. Perception of military event patterns in a two-alternative prediction task. February 1970. AD 707 379.

One objective of the TACTICAL OPERATIONS SYSTEMS (TOS) Work Unit is to provide research information by which decision making and information assimilation from displays may be facilitated. The present experiment dealt with aspects of perception fundamental to the recognition of sequence patterns of military activities. The objective was to develop empirical data useful in efforts to improve the recognition of such patterns and the anticipation of enemy moves.

Enlisted men ( $N = 48$ ) viewed sequences of military events representing eight patterns (form), high and low pattern strength, continuous versus discrete occurrence, and experience (from one to ten 100-trial periods) presented in systematic design on CRT screens. Subjects participated in two experimental sessions, each consisting of five 100-trial periods with 10-minute breaks. Each man worked individually and was self-paced. The task was to indicate which of two enemy activities, A(ttack) or R(est) was likely to follow each two previous events. They also indicated degree of confidence in their decisions.

When given event patterns occurred with high frequency (80% of the time), the decision maker learned to predict the third event as often as it occurred. However, when the pattern occurred less frequently (68% of the time), the men recognized only one of four critical patterns. Subjects' confidence in their predictions increased as their experience with the task increased. Confidence was affected by pattern form, but not by pattern strength nor continuity.

Activity patterns of an enemy may be the most tangible clues to his plans, and recognition of these patterns may be critical to successful military operations. The present findings have set tentative limits to the event patterns men can learn to recognize to a useful extent.

19. TRN 222. Sidney Epstein (System Development Corporation). Effects of image incongruence on location of common terrain in comparative cover. February 1970. AD 707 441

Comparative cover is image cover (in this case photographic) obtained at two different times over the same geographic area. It is used principally for change detection. For change detection, the common areas in the two image sets--the early and late cover--must be located. In a normal intelligence operation, the two sets of photographic cover are rarely at the same scale or orientation. Nor is it likely that the terrain overlap on a photo frame of early and late cover will be identical or even that the terrain depicted in one image will be completely included in the other. Differences in scale, orientation, and overlap of images could affect the interpreter's ability to locate the common areas. The present experiment was designed to determine the effects of such differences on an interpreter's performance in selecting comparative cover frames.

Ninety-six trained image interpreters were given the task of locating, on rolls of new photographic cover, frames depicting terrain in common with earlier photographic frames. Variation in the presentation of frames was controlled on percent of overlap and discrepancy in scale and orientation. Subjects and rolls of film were assigned to experimental conditions in a Graeco-Latin square counterbalanced arrangement.

All three types of departure from perfect congruence were found to degrade interpreter performance. The greatest effect was found with departure from 100 percent overlap, which increased working time and the number of inventive errors while decreasing completeness of frame selection and interpreter confidence in his responses. Scale discrepancy decreased completeness and increased the number of inventive errors but had no significant effect on working time or expressions of confidence in responses. Orientation discrepancy degraded all aspects of performance, but to a somewhat lesser extent than did reduction in percent of overlap.

20. TRN 223. Aaron Hyman, James H. Banks, and Jack J. Sternberg. Human performance experimentation in night operations: Technology and instrumentation for field research. June 1970.

Field experimentation methodology and technology were needed to deal with human performance problems associated with night operations, and particularly with the use of night vision devices and sensors. Concepts of instrumentation essential to field testing were initially developed from field experience during BESRL's exploratory research on night vision devices at Fort Benning, Georgia in 1967-68 (See 7, TRR 1164),

and more fully developed after the BESRL Field Experimentation Unit began work on night operations at Fort Ord, California in October 1968 (6, TRR 1163). Instrumentation embodying the requirements and essential characteristics as specified was constructed and evaluated in more recent experimentation.

The instrumentation system developed permits continuous real-time monitoring of operator performance during both training and testing, greatly enhancing the experimenter's ability to control operator activities. The system has shown a high degree of reliability, with minimum down time.

The universal device platforms (UDPs) developed can accept any passive night vision devices--and with minor modification other devices as well. Flexibility and variation in number and type of devices tested are thus built into the system. With the UDP, azimuth and elevation of a device can be determined with 0.1° accuracy. Hence, target acquisition can be determined much more accurately than with any non-instrumented system. Device orientation can be sampled five times per second, providing a fine-grained record of the search behavior of all participants in an experiment. Recording of target acquisition and search data on magnetic tape permits immediate computer analysis of the data and reduces analysis time.

## RESEARCH STUDIES

21. RS 69-11. Thomas J. Ryan. (Bunker-Ramo Corporation). Studies of tactical military decision making. II: An information network aid to scenario development. September 1969.

Basic to research on command information systems are relevant and objective performance measures for use in identifying factors contributing to the overall success or failure of the system and in assessing the capabilities of system or subsystem. The present publication describes an information network developed as an aid to preparation of scenarios for use in simulated performance measures for such evaluations.

The network was designed to structure a comprehensive data base which would support a variety of research studies of tactical military decision making. To this end, successively detailed categories of information were organized in terms of their relevance to the five general staff elements in military field commands. The framework of interacting information categories constituting the network is presented in the form of function flow block diagrams and associated data input sheets. The materials permit the user to trace the temporal flow of tactical information (by category and level of detail) through the decision making sequence involved. The steps help to clarify the complex interactions among categories of tactical information which may be called for by the decision maker.

The network facilitates the preparation of scenarios for simulations of operations in command information processing systems. The simulations are the basis for situation tests used in manned systems research on tactical decision making as affected by information flow and display standards.

22. RS 70-1. Harold Martinek and George F. Bigelow. Compendium of BESRL performance measures for image interpretation research. April 1970.

The Technical Support Branch of BESRL's Support Systems Research Division, among its other responsibilities, develops image interpretation performance measures to meet specific research requirements of BESRL scientists engaged in research on surveillance, intelligence, and command systems. As a basis for these measures, the Branch acquires, analyzes, and organizes multisensor imagery varying in scale, quality, content, and conditions under which obtained. Imagery maintained in the Branch Film Library as of 1 January 1968 was listed in BESRL Research Study 68-3. The present publication lists and describes the imagery and performance measures that have been developed on aerial roll film as of 1 January 1970.

The following information is given for each performance measure: Identification by roll number, number of rolls and number of frames in each roll, appropriate use and reference to relevant BESRL publication(s); content in terms of exercise on which flown, terrain, target areas and types; technical data--format, scale, quality, ground resolution, annotation, stereo/non-stereo, transparencies, positive/negative, how reproduced, and flight information; and form in which available for reproduction and use.

23. RS 70-2. Joanne M. Witt and Adele P. Narva. SIMPO-I Dynamic Army Model (DYNAMOD). May 1970.

Several dynamic mass-flow models by which the long-range effects of alternative personnel policies may be projected have been developed in BESRL's SIMPO (Simulation Models of Personnel Operations) work unit.

The Dynamic Army Model (DYNAMOD) is a computer simulation package consisting of four mass-flow models in which personnel are represented as categories of individuals having similar characteristics and assignment histories. Model I, the earliest and least flexible of the models, simulates the flow of personnel between four broad tours, one of which is a noncombat overseas tour. Model II, a widely used flexible general model, represents the flow of two parallel personnel systems with joint requirements. Model III, a modification of Model II, examines the effects of an alternative initial direction of personnel flow. Model IV, a general model, simulates the flow of two intersecting or parallel personnel systems each with a separate set of requirements. In one tour area, personnel are assigned in two different subsystems; in another tour area, all personnel are in one subsystem. The models also differ in the assignment priorities used and in the information input.

DYNAMOD models have been used in simulating the Army Aviator System for the Capabilities and Analysis Division of the Directorate of Procurement and Distribution and the Aviation Branch of the Directorate of Individual Training, Office of the Deputy Chief of Staff for Personnel, the staff of the Deputy Undersecretary of the Army for Operations Research, the Executive for Army Aviation in the Office of Personnel Operations, and the Office of the Undersecretary of Defense for Systems Analysis.

24. RS 70-3. Leonard C. Seeley. Survey of attrition factors among WAC Basic Trainees. April 1970 (Limited distribution).

Reports on a special purpose survey conducted among WAC enlisted women at the request of the Director of the WAC.

25. RS 70-4: Joyce L. House and Stanley L. Cohen. Current procedures in selection, training, and utilization of voice processors (Unclassified title). April 1970. CONFIDENTIAL

26. RS 70-5 Richard F. Dean. Operator performance variables in LEFOX GREY (Unclassified title). May 1970. CONFIDENTIAL

#### RESEARCH MEMORANDUMS

27. RM 69-1. Roger L. Williamson. Comparison of ASVAB and ACB scores. July 1969.

The seven cognitive tests of the Army Classification Battery (ACB) and counterpart tests of the Armed Services Vocational Aptitude Battery (ASVAB) (See 4, TRR 1161) were analyzed to provide comparability data for possible operational use of ASVAB scores in place of ACB scores. Good agreement between counterpart tests on the two batteries was indicated. Also, intercorrelations of ASVAB and ACB tests formed similar cluster patterns.

28. RM 70-1. William H. Helme. Analysis of officer performance of an experimental task: March Order. January 1970.

To provide criterion data for BESRL's longitudinal study on the differential prediction of officer performance, 900 officers who had taken the experimental Differential Officer Battery at entry on active service went through an integrated exercise of 15 tasks under simulated combat conditions at the Officer Evaluation Center established for the purpose at Fort McClellan, Alabama. Observed and recorded data on each task are analyzed to delineate dimensions of performance measured and to provide scores on these dimensions for use in the validation of the predictor measures



Factor analysis of the March Order task data presented here resulted in eleven component scores and a total task score. Six components represented aspects of officer responsibility in planning the march order. Other components were: administrative provisions, personnel interactions, evaluations on command behavior, and drive to accomplish mission.

29. RM 70-2. Eli Frankfeldt. Use of the Army Classification Battery for counseling and assignment to non-Army training. March 1970.

In the implementation of Project TRANSITION, use of Army Classification Battery (ACB) scores as an aid in referral of applicants for training was recommended by BESRL. A comparison of ACB tests and tests used routinely with civilian applicants for the IBM Office Equipment Repair Course lent support to this use of the ACB tests. The General Maintenance (GM) Aptitude Area had a validity coefficient of about .40 in the sample analyzed.

30. RM 70-3. William H. Helme. Analysis of officer performance of an experimental task: Highway Traffic Plan. May 1970.

Reports on the factor analysis of performance data on another of the 15 tasks constituting the Officer Evaluation Center exercise (See 28, RM 70-1 above). Five major factors were defined: total objective score, response to stress, procedural skills, attention to requirements, and style of performance.

## WORK UNITS

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### U. S. Army Behavior and Systems Research Laboratory

Work Units included in the BESRL Research and Development Work Program for FY 1970 are briefly described. Units are grouped according to research area. Numbers appearing at the conclusion of each description designate publications abstracted or listed on pages 3 through 20.

#### PERSONNEL MANAGEMENT RESEARCH--SELECTION AND BEHAVIORAL EVALUATION

Selection research for military personnel management embraces research on selection and classification of enlisted men and on the performance evaluation of both officer and enlisted behavior for use in assignment, promotion, and advanced training. Findings have implications for manpower planning and career development of officer leaders. Empirically based information is provided on the optimum mental distribution of enlisted men within units, for example, and the means of early identification of individual assets essential to high level performance in different areas of military activity. In addition to general trainability and potential or acquired capabilities for defined occupational areas, such assets include combat potential, ability to function well as a team member, officer leadership qualities, and career motivation.

Studies to improve enlisted classification have recently centered on interaction between job environment and the predictive effectiveness of classification tests, both operational and innovative. In behavioral evaluation, an important aspect of the research is the development of improved methods of assessing officer performance, including simulation exercises and variations in rating techniques.

Added research effort goes into the development of technical information for use in consultative assistance to staff agencies responsible for procurement and standards policies and to Department of Defense officials for use in manpower studies and programs. Implementation is by such policy and operating agencies as DCSPER, OPO, and USCONARC in programs which include selection for OCS and ROTC, the screening, classification, and job assignment of enlisted personnel, and the officer personnel management system.

WORK UNIT: Interface between Civilian and Military Enlisted Manpower Systems. FY 1970.

Army induction and enlistment policy bases acceptance in large part on measures of aptitudes related to likelihood of successful performance in Army jobs. A growing body of psychometric methodology is developed and applied in updating--or developing replacements for--measures of general military trainability and supplementary measures of specific aptitudes. Research products must reflect military policy and organization as well as standards for military service established by the Congress.

Instruments now in operational use include the Armed Forces Qualification Test--overall measure of trainability for both enlistees and inductees; the Army Qualification Battery, a set of short tests to evaluate specific abilities; special devices to aid in identifying deliberate failures; and the Enlistment Screening Test administered by recruiters to determine whether men seeking to enlist are likely to meet mental standards for service and should be sent on to Armed Forces Examining and Entrance Stations for further testing. Tests for women applicants for enlisted service include preenlistment screening and qualification tests. An instrument more recently introduced is the Armed Services Vocational Aptitude Battery (ASVAB) developed in response to need for tests which could be used by all the services to test high school seniors for career counseling and as potential enlistees.

ASVAB development was the first result from a joint accelerated research program to determine which aptitude tests of the services were sufficiently interchangeable to permit of an all-service battery. Joint service studies of the appropriateness of the current ASVAB continue, and BESRL is leading in-house and contract research in the current effort to develop alternate ASVAB forms.

The work unit has for several years engaged in methodological research on unconventional testing techniques as possible means of extracting from tests additional information predictive of soldier potential. Included are very short limited-range tests for go-no-go screening, disguised aptitude tests as a new approach to detecting deliberate failures, and branching tests programmed for computer administration. 4, 13, 24.

WORK UNIT: Differential Classification of Enlisted Manpower. FY 1970.

The objective of initial classification is to achieve optimal utilization of enlisted personnel across the range of Army jobs by matching the potential and developed skills of available manpower to training program and job requirements. The research objective is to develop and maintain measures of maximal differential value--measures highly valid for one set of Military Occupational Specialities (MOS) and of relatively low validity for other MOS.

The Army Classification Battery (ACB) was developed by BESRL to improve the classification of enlisted manpower. Recent effort has been toward improvement of the differentiating power of the battery predictors so as to better distinguish potential for success in different MOS groups. Major effort has gone into reconstituting the aptitude areas derived from the ACB. Another important emphasis is on devising additional test content reflecting motivation. A long-term research effort has resulted in the experimental Army Differential MOS Battery. The new battery has been analyzed in a sample of about 25,000 enlisted men in over 100 training courses. The effectiveness of the measures is being determined for the conditions under which the tests are to be used, both in training and on the job.

The emphasis of the work unit has been expanded to include a major study of conditions in the Army which affect the validity of the classification predictors. An important segment of current effort is the investigation of interactions between job environment and the effectiveness of classification tests. The Army is redesigning training courses to reduce emphasis on abstract material and increase the task-oriented material, so that trainees emerge with more specific skills. This change may affect the way men are assigned and utilized on the job, and in turn may alter the validity pattern of the ACB tests. 2, 27, 29.

**WORK UNIT:** Optimum Distribution of Individual Abilities for Unit Effectiveness. FY 1970.

The performance of marginally qualifying personnel in individual jobs has received considerable attention, and a substantial body of findings on the aptitude and ability levels significant for performance in selected groups of jobs has accumulated--with emphasis on the adequacy with which individuals in given mental categories meet training demands. However, the general impact of different mental standards for enlisted input on unit effectiveness has not been satisfactorily evaluated. The question for management is not whether an individual of marginal ability can barely get along in a job. Rather, it is what balance of ability levels is needed for a unit as a whole to be effective in its mission.

The OPTIMUM MENTAL DISTRIBUTION Work Unit has the ultimate objective of determining optimum numbers of enlisted men at different levels of ability which Army organizations can absorb and still maintain effectiveness. As a major step to this goal, measures of the effectiveness of individuals and of small military units are being developed so that units of varying composition can be compared. The performance measures are designed to take into account not only mission accomplishment but also training and supervision demands, disciplinary actions, and other cost factors as they relate to the utility of marginal personnel.

In FY 1969 and 1970, rifle squad performance was studied and field research was launched to cover mechanized infantry squads and motor maintenance sections. Through this field research, a hypothesis is being developed. The main premise is that effective leadership and chain of command moderates the impact of manpower quality on unit performance,

the relationship differing with different types of unit activity. A question to be explored is whether there are break-points at which leadership cannot compensate for poor quality of manpower.

Methods include both field experiment and use of mathematical models where feasible for computer simulation of projected conditions. The effort looks to the development of models which will make it possible to estimate the effect of prospective changes in standards and to set input requirements for different force structure and mobilization plans.

**WORK UNIT: Prediction of Officer Performance and Retention. FY 1970.**

The OFFICER PREDICTION Work Unit was established to provide the Army with improved techniques for identifying officers who have aptitudes and other characteristics to meet the differing demands of different officer assignments. The basic research design involved development of experimental predictors and the differential validation of the predictors against situational performance criteria and evaluations of field performance. The U. S. Army Officer Evaluation Center (OEC) at Fort McClellan completed the unique mission of staging a continuous three-day exercise which provided criterion evaluations of 900 officers previously tested with the experimental battery.

With U. S. activity in Vietnam, the effort of the OFFICER PREDICTION Work Unit was redirected to permit collection of human performance data in up-to-date combat or combat-ready settings. The basic design remained the same: development and administration of experimental psychological predictors, collection of measures of human performance, analysis of predictors against criteria, and follow-up to identify qualified officers who remain on active duty beyond their obligated service. The performance of the 900-officer sample who had taken the predictors and who were evaluated at the OEC was still relied upon as the major data source for differential validity analysis. In the meantime, officers originally given the experimental screening measures and still on active duty have been followed up in order to validate the predictors against performance demonstrated beyond the OEC. Evaluations of such actual performance were obtained in Vietnam, Europe, and elsewhere. In addition to the predictors and evaluation procedures developed, research findings provide valuable insights into the dimensions of officer leadership behavior in varied situational context. 28, 30.

**WORK UNIT: Officer Performance Evaluation Systems. FY 1970.**

DCSPER has established a priority requirement for improved officer performance evaluation and institution of a continuing record of officer performance. In response, BESRL in FY 1969 began a research program to develop new and improved officer performance evaluations for use at career decision points and to integrate the evaluation procedures into an operational officer performance evaluation system.

In the early 1950's, BESRL conducted a series of major studies on rating methodology and developed a sequence of Officer Efficiency Report Forms which were capable of providing discriminating ratings. The forms did not, however, have generally favorable acceptance by officers. Subsequent rating methods have afforded more descriptive evaluations. Meantime, improved tools and techniques involving computer-assisted simulation and analysis of ratings by peers and supervisors in both group and individual situations have been the subject of experimentation in organizational and industrial settings.

Making use of the new and more fruitful constructs that have emerged, BESRL research is moving toward construction of a model defining the requirements of an officer performance evaluation system based on analysis of officer assignment, school selection, and promotion policies. Areas of focus include analysis of the operational factors and constraints in the assignment, school selection, and promotion of officers, and the application of special rating techniques to supplement the operational evaluations of senior officers.

**WORK UNIT:** Psychological Measures for Use in Primary Officer Selection and Evaluation Programs. FY 1970.

Major primary training programs through which the Army obtains officers for commissioning are the U. S. Military Academy, the senior division of the Reserve Officer Training Corps, and the Army's officer candidate schools. Work now in progress includes research in each of the officer procurement programs to meet the changed needs of the Army. Selection procedures for the ROTC program as the Army's major source for commissioned officers are studied with a view to developing techniques effective in identifying candidates with high leadership potential. In the OCS program, the selection procedure is studied with the objective of developing and validating a "whole man" evaluation that will accommodate changes in quotas and quality of applicants. The possible application of measures and concepts developed in OFFICER PREDICTION research is being explored. Research assistance is being provided the United States Military Academy in research on cadet leadership and attrition and evaluation of USMA graduates.

Current and projected emphasis is on devising methods and techniques for early identification and development of the leadership potential of cadets and junior officers from whatever source. The objective is to aid the Army in selecting high quality candidates for input into the primary officer procurement programs and to enhance career motivation and performance through continuing development and evaluation of that potential.

## PERSONNEL MANAGEMENT RESEARCH--MANPOWER MANAGEMENT

Direct solutions are sought to problems involving development and implementation of mathematical manpower models to assist in manpower processing, planning and policy formulation, and quantitative models and computer aided simulation research relating to human behavior and/or personnel utilization. Methodology is developed and evaluated which builds on operations research capability, model sampling techniques, and computer technology to evaluate systems performance where the human element is critical and to provide means of optimizing manpower utilization.

WORK UNIT: Simulation Models of Personnel Policies and Operations II, SIMPO-II. FY 1970.

The SIMPO-II effort constitutes a continuation and extension of the work accomplished in SIMPO-I. Models developed in the SIMPO-I effort have found application at the manpower policy analysis level as tools for both the one-time assessment of proposed policy change and the periodic analysis of the projected state of the Army personnel system. The products include a simulation program library including the General Entity Simulator (GES), a relatively general bulk flow model, and several specialized simulation models. Specifically identified as part of this effort was the completion of a simulation model to describe the total personnel flow world-wide which addresses the impact of personnel policies relating to deployability of personnel.

Objectives of SIMPO-II are 1) to develop new approaches and techniques for use in computerized models of manpower/personnel systems which may be used by management in evaluation of alternative policies, 2) to determine the effectiveness and efficiency of these approaches, 3) to apply the new approaches and techniques to models developed in SIMPO-I to extend their usefulness as operations research tools, and 4) to develop new SIMPO-II models capable of solving additional kinds of manpower/personnel management problems.

Basic entity simulation models developed by BESRL under the SIMPO-I effort, and other techniques and models developed in the OPTIMIZATION MODELS Work Unit, will be used in modified form to assess the impact of personnel actions and decisions determined by aptitude, achievement, or experiential characteristics of individual enlisted personnel, but as a separate Work Unit entitled Enlisted Career Planning Systems Research.

The SIMPO effort includes consultation and problem formulation for model users, adaptation and exercise of models in response to user requirements, and development of new models when judged appropriate. 5, 12, 23.

WORK UNIT: Optimization Models for Manpower Operations Research. FY 1970.

BESRL's basic contributions to quantitative methodology relating to the inventory, allocation, and quality control of personnel, extending back a decade or more, are continued in this Work Unit. BESRL has developed optimization techniques for use in conjunction with computerized models and advocated their application in Army manpower management. Special attention has been given to application of quantitative models and computer-aided methods for optimally assigning personnel and to developing more efficient methodology and instruments for accomplishing optimal allocation.

Research has been conducted to assess the feasibility of alternative approaches to optimal assignment of enlisted men, and for determining the gains that could accrue from a computerized optimal assignment procedure. Feasible quantitative models and computing algorithms for optimal assignment of enlisted men have been produced. Model sampling studies have dealt with a number of questions relating to the effect on the predicted average performance of individuals of varying characteristics of classification test battery and personnel information systems, when optimal assignment procedures are being utilized in the system under study.

#### HUMAN PERFORMANCE EXPERIMENTATION

Experimentation in this area involves research on behavioral functions and systems aspects related to critical tasks and subtasks common to a wide variety of Army jobs. Typical end products and applications are work methods, basis of issue and mix, work-rest cycles, supervisory techniques, information input and response output procedures, and man-machine interface. Means of improving performance that are determined to be successful in the laboratory setting are evaluated by field research in an operational setting. Research effort is responsive to the STANO program with regard to night observation devices, to ASA requirements, particularly those related to intercept operator performance, and to aspects of SAFEGUARD and TACFIRE related to controller performance.

WORK UNIT: Dependable Performance in Monitor Jobs. FY 1970.

The complex weapons and surveillance systems of the modern Army have created many new types of monitoring jobs. In some of these jobs, operators are required to detect and identify a variety of visual and auditory signals which are weak, fleeting, and unpredictable in occurrence. Operators must make fairly simple responses at appropriate times, and must continue to respond accurately and quickly during long work hours under fatiguing or boring conditions. Under such conditions, successful performance depends as much upon the operator's ability to remain alert and vigilant as it does upon his technical skills.



In other jobs, the operator is required to discriminate critical signals from very similar but unimportant signals in an active signal environment. Jobs of the latter type involve not only the problems of vigilance but also operator judgment based on the integration of information from multiple sources.

The MONITOR PERFORMANCE Work Unit emphasizes applied vigilance research through simulation of the relevant aspects of many of these Army monitor jobs in a laboratory setting where experimental controls can be maintained. The objective is to develop and test principles, techniques, and operating procedures to improve performance of individuals working in a variety of monitor jobs. Laboratory apparatus capable of simultaneous or independent presentation of many different signals on meters, speakers, dials, scopes, lights, and alpha-numeric displays are used to investigate the effects on monitor response of factors associated with signals, task, environment, and the individual.

The effort is currently conducted as four work subunits: 1) Laboratory studies of monitoring behavior, 2) Enhancement of communications operator performance, 3) Human performance factors in communications analysis and processing, and 4) Component analysis of operator procedures and information processing techniques. 25.25.

**WORK UNIT:** Human Performance Experimentation in Night Operations. FY 1970.

Increasing need to improve night military operations has led to the development of sensors which improve night seeing ability and night target acquisition. Important human factors problems in the use of these technological devices remain to be resolved. Salient questions are: Who should use which devices and under what conditions? How should the devices be used? What should be the basis of issue and mix?

However promising these devices are, the human element in their use, as well as their tactical employment, enters into their effectiveness. The NIGHT OPERATIONS Work Unit is a major research effort to enhance night observation performance with and without instrumentation. Included is research to determine the effects of sustained activity on human performance during night operations, the effects of prolonged use of night vision equipment, and optimum work cycles and team procedures under varying conditions of illumination, targets, and terrain.

To accomplish this research, a BESRL field experimentation unit has been established at Fort Ord, California, and data collection has been completed on several phases of a research effort in support of the SEA NITEOPS evaluations and STANO. These initial phases have dealt with relative performance and work methods with selected passive night vision devices. Analyses have provided insights into the effects of prolonged activity, inferences for basis of issue and mix, implications for search techniques to be employed, and guidelines for training and future design of equipment. Information was also generated on the effects on soldier performance of variables such as ambient light conditions, and target contrast, type, movement, and distance. 6.7.20.

**WORK UNIT: Dependable Performance in Controller Jobs. FY 1970.**

Complex man-machine interfaces are appearing on the military scene with increasing frequency. Many of these require the human controller to stay alert for long periods of time to the input of critical information from complex equipment, higher control levels, and/or subordinate levels, and to act quickly and precisely when such information appears. Displays are usually visual but can include audio and kinesthetic elements. They can be real-world, synthetic, or combinations of the two, and most often require assessments, decision, and response in real time. The CONTROLLER PERFORMANCE Work Unit was established to develop and test more effective controller procedures and more effective methods of identifying and assigning personnel in controller jobs.

Initial research focuses on controller performance critical to combat operations involving computer applications to air defense and artillery fire missions. Task and skill analysis methodology is being applied to critical controller functions to identify tasks and task elements appearing across jobs and having a potential for reduction in demands upon fallible human perceptual and cognitive processes. Alternative methods and procedures for improved speed, accuracy, and reliability of response will be devised and tested under controlled laboratory conditions and subsequently in the field. Research in this area is a further application of the iterative laboratory/field method which characterizes BESRL's human performance experimentation.

**WORK UNIT: Response Systems in Human Performance. FY 1970.**

Covert human responses, generally involuntary and detectable only by instruments, have rarely been used in military situations. Exploring the possibility of such deliberate use is the focus of the present effort. Major objective is to determine whether covert response systems can be employed usefully and reliably to enhance human performance, particularly in military situations. If under certain conditions covert responding to signals is found to be more sensitive and rapid than overt reactions, then covert responding to critical information could be deliberately established through classical conditioning. When needed, responses could be recorded. For example, an image interpreter could be conditioned to give covert responses to displays containing a specific type of target. Later, when he is scanning reconnaissance displays for this specific target type, his covert responses could be recorded to obtain information not produced by overt responses.

Critical to the experimental aspect of each exploration is the development of new techniques for recording and processing electro-behavioral signals generated by the covert response systems, including devices of original design and the unique modification of extant equipment. Substantial progress has been made in these areas, including the development of telemetry techniques and new activity detection techniques for investigation of relationships between internal responses and overt performance.

## MANNED SYSTEMS RESEARCH

Manned systems research has as its principal objective the enhancement of human performance in relation to total system effectiveness. It involves experimentation with various configurations of systems components, considering interactions and trade-offs. The goal is to improve human performance within the system and also to provide means of evaluating systems effectiveness as a function of systems factors.

WORK UNIT: Tactical Information Processing (TIP). FY 1970.

The Army is developing Automatic Data Systems within the Army in the Field (ADSAF) for receipt, processing, storage, retrieval, and display of different types and vast amounts of military data. Research on the human components of these new systems has accomplished the following: Basic human factors problems were identified and organized around five critical information processing operations--screening incoming data, transforming raw data for input into storage-retrieval devices, input of information, assimilation of displayed information, and decision making. An experimental facility has been developed within BESRL's Information Systems Laboratory in which aspects of tactical functions are simulated. A number of research projects have been completed or are in progress on information assimilation and decision making. The effects on performance of such information factors as amount of information presented, coding, specificity, alpha-numeric versus graphic format, rate and degree of updating, use of hard copy, individual versus group procedures, probability data, decision alternatives, and consequences generated by man and computer are assessed. Results of these projects delineate human performance capabilities and limitations. They have implications for improved work methods for operational personnel and for increasing the efficiency of the information assimilation-decision process.

Another series of experiments concerns problems inherent in preparing information (screen, transform, input) for subsequent use. Apart from the effects on these operations of the factors listed above, other questions must be answered: How can personnel be best utilized in screening and transforming masses of information? Should they work as teams or as individuals? What aptitudes and skills are needed? Different work methods, techniques, and configurations of groups are tried out in various tasks to determine how accuracy, completeness, and speed of information processing are affected. 1, 9, 21.

**WORK UNIT: Tactical Operations Systems (TOS). FY 1970.**

The Army's Tactical Operations System (TOS) is a complex man-equipment organization. A clear understanding of the various parts, functions, and interrelationships is required to assure total system effectiveness. The BESRL Command Systems Field Branch located with the 7th Army TOS Development Group in USAREUR between 1967 and 1970 performed research in an operational setting and furnished human factors assistance to TOS evaluation efforts.

An experimental facility has been developed within BESRL's Information Systems Laboratory in which aspects of tactical functions are simulated. Research scientists conduct research on information requirements, criterion measures for evaluating performance at various levels, data input and display functions, and decision making in the field. The TOS itself is part of a larger complex within which mutual dependencies exist. Problems of centralization-decentralization and extent of overlap in the data bases maintained in the various systems come under research scrutiny in relation to the requirements for capability of independent action.

BESRL research yields assistance to users and developers of command systems in the form of findings regarding 1) allocation of functions to men and equipment, 2) identification of appropriate personnel for critical positions, 3) objective performance measures for the evaluation of man-machine interaction, 4) emergency manual back-up systems, and 5) differing system configurations. 1, 9, 18.

**WORK UNIT: The Determination of Interpreter Techniques in a Surveillance Facility. FY 1970.**

The need to handle large volumes of static and dynamic (real-time) imagery of various types (photographic, infrared, and radar) in new tactical interpretation facilities demands critical examination of the tasks and duties of the interpreter.

Research on interpreter functions within existing systems was initiated by BESRL in FY 1965. Early studies established the necessity for enhancing both the accuracy and completeness of interpretation to meet the crucial and exacting demands of modern tactical operations. An expanded research effort was formulated to apply to the broad area of surveillance systems. The research is conducted as an in-house effort, augmented by research contracts with organizations selected as having superior capabilities and facilities for research in aerial surveillance. Within BESRL, an Information Systems Laboratory has been established in which computerized equipment is used to simulate variations in display mode, image quality, image enhancement devices, and other aspects of information processing specified for experimentation.

The INTERPRETER TECHNIQUES Work Unit focuses on developing work methods and procedures which, through the most efficient use of human abilities, maximize the accuracy, completeness, the speed with which intelligence information is derived from imagery. Imagery interpretability and the nature of interpreter errors are prime areas of investigation to determine threshold conditions and diagnose difficulties.

BESRL findings indicate that many factors influence performance: the imagery, its content, quality, and scale; the requirements placed on the interpreter in terms of accuracy, completeness, and speed; the man, his ability, background, and experience; and the display and equipment with which he works. Studies of these factors, severally and in combination, provide direction for method of achieving gain in interpreter performance.

Special studies have concentrated on screening quantities of imagery to select the most promising frames for more intensive interpretation, methods of detecting change in imagery obtained at different times (including use of computer analysis), methods of dealing with infrared and SLAR imagery for better interpretation through systematic identification and consolidation of cues and signatures. 3, 8, 17, 19.

**WORK UNIT:** Influence of Displays on Image Interpreter Performance. FY 1970.

In systems concerned with obtaining, processing, and displaying imagery for the extraction of intelligence information, the interface problem of relating human performance to display characteristics must be considered. In BESRL's Information Systems Laboratory, a variety of display characteristics and conditions can be tested to determine appropriate conditions for imagery acquisition and the most efficient presentation for tactical imagery and related reference materials.

Experiments have been conducted to determine how performance is affected by variation in the characteristics of the photos displayed--magnification and orientation, for example--and by the nature and content of references and reporting devices used by the interpreter. Recent work has been concerned with the relationship of image quality to information extraction, the evaluation of selected characteristics of photographic references, and the effects of imagery transmission on performance. In addition, alternative target entry and correction procedures using such input/output devices as teletypewriters, cathode ray tubes with associated typewriter, and fixed response keyboards, interfaced in the laboratory with a digital computer, have been the subject of experimentation.

Work on the interpretability of infrared and radar imagery has progressed to the stage where a number of interpretation difficulties have been identified, together with cues and signatures that may lead to improved performance. Based on these cues and signatures, reference materials of increased usefulness to the interpreter can be assembled. 3, 10.

**WORK UNIT:** Information Processing in Advanced Image Interpretation Systems. FY 1970.

Intrinsic to the development of an effective advanced surveillance information processing system are: the rapid retrieval of required reference information; the specification of required team methods and communication links among personnel; and the delineation of procedures for controlling system operations and interpreter decision processes. It is then necessary to test the total system configuration of men, equipment, and procedures and compare it with reasonable alternatives under operational conditions. On the basis of such evaluation, modifications and improvements are introduced. The studies in the IMAGE SYSTEMS Work Unit are directed toward the fulfillment of these objectives, thereby contributing to the orderly development of a highly effective, smoothly functioning system.

Research to date has studied how the efforts of a number of interpreters can best be combined in team operations to meet system demands for increased accuracy, completeness, and timeliness. Computer-aided procedures for use in selecting reference keys have also been developed and experimentally evaluated. Work has been initiated on the establishment of a decision matrix approach to controlling interpretation systems output. A convenient means of establishing the trade-off costs of interpretation errors of various types has been established.

A standard measurement package for assessing the comparative performance of alternative concepts and configurations has been completed. The package includes all materials and instructions (including scenario with attendant imagery, data collection and reporting forms, and scoring rules and criteria) necessary for evaluating and comparing a variety of tactical image interpretation facilities. A simulated advanced facility has been developed and tested in BESRL's Information Systems Laboratory for the purpose of exercising the standard measurement package and developing a sound model for further systems research. 3, 11, 15, 16.

**WORK UNIT:** Intelligence Information Processing Systems. FY 1970.

The need for continually updating intelligence appraisals while absorbing and evaluating incoming information from a great variety of sources imposes a severe burden on the intelligence analyst. He must judge source reliability and information accuracy, determine relevancy and decay rates, and consider information gaps while integrating and interpreting large amounts of different kinds of information.

Emphasis in BESRL's INFORMATION SYSTEMS Work Unit is on the critical human functions of analysis and interpretation. The aim is to identify automated data handling techniques, computer aids, and procedural and analytic techniques which will greatly enhance speed and accuracy of intelligence analysis and prediction. Inputting, flow, and processing functions are being investigated in terms of tailoring these to the analyst/G2 requirements and accommodating direct input from a variety of sensors and sensor fields. The emphasis of the effort is on how intelligence functions should be performed rather than on how they are now performed. It is planned to accomplish the research on an evolutionary

"test as you go" basis, with specific techniques and aids being evaluated in the Information Systems Laboratory to cull and refine. Promising methods and programs will be integrated into an experimental data base until a total simulated system has been defined. The total system will then be mocked up and experimentally evaluated. 3.

WORK UNIT: Basic Characteristics of Image Interpretation Performance Measures. FY 1970.

Beginning in FY 1965, the Technical Support Branch of BESRL's Support Systems Research Division has amassed an aerial film library for use in research in image interpretation. From this imagery, performance measures are developed to meet specific research requirements.

Psychometric characteristics of the performance measures--means, variance, item difficulty, test reliability, intercorrelation, and part-whole correlation--are determined through analysis of data obtained by administering the tests to trained image interpreters. This information is used to select the best performance measures available for given research needs and also to develop indices for matching groups of experimental subjects.

A compendium of performance measures which have been used in BESRL image interpretation research and which may be useful to interested research organizations has been prepared. 22.

#### TECHNICAL ADVISORY SERVICE

BESRL research scientists provide technical advisory services to various elements of military management on a wide range of behavioral science problems. Services include consultative assistance on application of research findings to operational problems, evaluation of personnel and manpower policies and proposals and implications of concepts emerging from research, assistance with problems of research planning, design of experiments, and interpretation of findings, evaluation of concepts and contractor proposals in the area of human performance and manned systems research, and participation in study and planning groups Army- and service-wide, such as ad hoc working groups for the Manpower Management Planning Board on interservice problems, the Army Mathematics Steering Committee, the Armed Forces-NRC Vision Committee, and the Joint Chiefs of Staff ISCIG Multi-Sensory Correlating Committee.

## IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

A limited portion of the research effort of the Behavior and Systems Research Laboratory is devoted to the conduct of original research on subjects which need to be pursued because of possible long-range significance for military developments but which are of less immediate applicability than the main body of the research conducted. Scientific talent is directed toward the exploration of new developments in experimental psychology, psychometrics, statistical-mathematical models and other operations research methodology. Laboratory capability may thus be extended in terms of knowledge, techniques, and facilities which may ultimately be applicable in research on a wide range of Army activities.



## DEPOSITORY LIBRARIES

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### BESRL Research Publications

BESRL Technical Research Reports and Research Notes are on file in each of the following libraries, listed by state.

#### Alabama

University of Alabama Library  
Reference Department  
University, Alabama 35486

Auburn University  
Ralph Brown Draughon Library  
Serials Department  
Auburn, Alabama 36830

#### Alaska

University of Alaska Library  
Government Documents Division  
College, Alaska 99735

#### Arizona

Arizona State University  
Matthews Library  
Documents Librarian  
Tempe, Arizona 85281

University of Arizona Library  
Acquisitions Department  
Tucson, Arizona 85721

#### Arkansas

Arkansas State College Library  
Acquisitions Librarian  
State College, Arkansas 72467

#### California

University of California  
General Library  
Documents Department  
Berkeley, California 94720

University of California Library  
Government Publications Room  
405 Hilgard Avenue  
Los Angeles, California 90024

California State Library  
Documents Section  
Sacramento, California 95809

San Diego State College Library  
San Diego, California 92115

The Hannold Library  
Documents Department  
Claremont, California 91711

University of California Library  
Documents Section  
Riverside, California 92502

University of California Library  
Government Publications Department  
Santa Barbara, California 93106

California State College at Los Angeles  
John F. Kennedy Memorial Library  
Documents Section  
5151 State College Drive  
Los Angeles, California 90032

California (Continued)

Library  
Occidental College  
1600 Campus Road  
Los Angeles, California 90041

Documents Section  
The University Library  
University of California  
Santa Cruz, California 95060

Chico State College Library  
Chico, California 95927

Fresno State College Library  
Government Publications Department  
Fresno, California 93726

University of California Library  
Documents Department  
Davis, California 95616

Library, University of  
Southern California  
700 West 35th Place  
Los Angeles, California 90007

University of California Library  
Government Publications Section  
Irvine, California 92650

San Fernando Valley State College  
Library-Acquisitions Department  
18111 Nordhoff Street  
Northridge, California 91324

Government Publications Collection  
San Francisco State College Library  
1630 Holloway Avenue  
San Francisco, California 94132

Connecticut

Wesleyan University, The Library  
Middletown, Connecticut 06457

Connecticut (Continued)

University of Bridgeport Library  
Bridgeport, Connecticut 06602

Delaware

University of Delaware  
Morris Library  
Documents Department  
Newark, Delaware 19711

District of Columbia

Library of Congress  
Washington, D. C. 20540

Florida

Florida State University Library  
Documents Division  
Tallahassee, Florida 32306

University of Florida Libraries  
Documents Division  
Gainesville, Florida 32603

Georgia

University of Georgia  
The University Libraries  
Documents Section  
Athens, Georgia 30602

Hawaii

University of Hawaii Library  
Government Documents Collection  
2425 Campus Road  
Honolulu, Hawaii 96822

Illinois

University of Illinois Library  
Documents Division  
Urbana, Illinois 61803

Northwestern University Library  
Documents Department  
Evanston, Illinois 60201

University of Chicago Library  
Documents Librarian  
Chicago, Illinois 60637

Illinois State University  
Milner Library  
Acquisitions Department  
Normal, Illinois 61761

Southern Illinois University  
The General Library  
Serials Department  
Carbondale, Illinois 62903

Northern Illinois University  
Library  
Documents Department  
DeKalb, Illinois 60115

Western Illinois University Library  
Documents Librarian  
Macomb, Illinois 61455

University of Illinois  
at Chicago Circle  
Documents Section  
P. O. Box 8198  
Chicago, Illinois 60680

Indiana

Purdue University Library  
Reference Unit  
Lafayette, Indiana 47907

Indiana (Continued)

Indiana State Documents Librarian  
140 N. Senate Avenue  
Indianapolis, Indiana 46204

Indiana University Library  
Documents Librarian  
Bloomington, Indiana 47405

Indiana State University  
Cunningham Memorial Library  
Documents Librarian  
Terre Haute, Indiana 47809

Ball State University Library  
Muncie, Indiana 47306

University of Notre Dame  
Acquisitions Dept. (277449A)  
Memorial Library  
Notre Dame, Indiana 46556

Iowa

State College of Iowa  
Library - Serials - A  
Cedar Falls, Iowa 50613

Iowa State University of Science  
and Technology  
The Library  
Ames, Iowa 50010

Cowles Library  
Drake University  
Des Moines, Iowa 50311

Kansas

University of Kansas Library  
Documents Librarian  
Lawrence, Kansas 66045

Kansas State University Library  
Acquisitions  
Manhattan, Kansas 66502

Kentucky

University of Kentucky  
University Libraries  
Continuation Division  
Acquisition Department  
Lexington, Kentucky 40506

University of Louisville Library  
Documents Librarian  
Louisville, Kentucky 40208

Western Kentucky University Library  
Director of Library Services  
Bowling Green, Kentucky 42101

Louisiana

Louisiana State University Library  
Government Documents Department  
Baton Rouge, Louisiana 70803

Maine

University of Maine  
Raymond H. Fogler Library  
Documents Librarian  
Orono, Maine 04473

Maryland

University of Maryland  
McKeldin Library  
Social Science Department  
College Park, Maryland 20742

Johns Hopkins University Library  
Acquisitions  
Baltimore, Maryland 21218

Massachusetts

University of Massachusetts  
Amherst, Massachusetts

Boston College  
Bapst Library  
Serials Librarian  
Chestnut Hill, Massachusetts 02167

Michigan

Detroit Public Library  
5201 Woodward Avenue  
Detroit, Michigan 48202

University of Michigan Library  
Documents Librarian  
Ann Arbor, Michigan 48104

Michigan State University Library  
Documents Librarian  
East Lansing, Michigan 48823

Wayne State University Library  
Documents Librarian  
Detroit, Michigan 48202

Western Michigan University  
Dwight B. Waldo Library  
Documents Librarian  
Kalamazoo, Michigan 49001

Documents Librarian  
Central Michigan University Library  
Mount Pleasant, Michigan 48858

Documents Library  
Oakland University  
Rock, Michigan 49880

Minnesota

University of Minnesota  
Walter Library  
Documents Division  
Minneapolis, Minnesota 55455

Mississippi

Mississippi State University  
Mitchell Memorial Library  
Acquisition Department  
Serials Section - Box 1517  
State College, Mississippi 39762

University of Southern  
Mississippi Library  
P. O. Box 53, Station A  
Hattiesburg, Mississippi 39401

Missouri

Kansas City Public Library  
Documents Division  
1211 McGee Street  
Kansas City, Missouri 64106

University of Missouri Library  
Serials Documents  
Columbia, Missouri 65202

Nebraska

University of Nebraska Library  
Documents Librarian  
Lincoln, Nebraska 68508

New Hampshire

Dartmouth College  
Baker Library  
Reference Department  
Hanover, New Hampshire 03755

New Jersey

Princeton University Library  
Documents Librarian  
Princeton, New Jersey 08540

New Jersey (Continued)

Rutgers University Library  
Periodical Department  
New Brunswick, New Jersey 08901

New Mexico

University of New Mexico  
Zimmerman Library  
Serials Department  
Albuquerque, New Mexico 87106

New York

Brooklyn Public Library  
Documents Division  
Grand Army Plaza  
Brooklyn, New York 11238

Columbia University Libraries  
Documents Acquisition  
535 West 114th Street  
New York, New York 10018

Cornell University Libraries  
Government Documents  
Ithaca, New York 14850

New York Public Library  
Government Documents  
5th Avenue and 42nd Street  
New York, New York 10018

New York State Library  
Gift and Exchange Section  
Albany, New York 12224

Syracuse University Library  
Serials Division  
Syracuse, New York 13210

Documents Librarian  
Hunter College of the City  
University of New York,  
695 Park Avenue  
New York, New York 10020

New York (Continued)

United Nations  
Dag Hammarskjold Library  
Acquisition Section  
New York, New York 10017

State University College Library  
Documents Librarian  
Potsdam, New York 13676

State University College  
Milne Library  
Geneseo, New York 14454

Main Library, Documents Section  
State University of New York  
at Stony Brook  
Stony Brook, New York 11790

State University College  
James M. Milne Library  
Oneonta, New York 13820

Hofstra University Library  
Documents Department  
Hempstead, New York 11550

Association of the Bar of the  
City of New York  
42 West 114th Street  
New York, New York 10036

Nassau Library System  
Reference Department  
Lower Concourse, Roosevelt Field  
Garden City, New York 11530

University of Rochester  
Kush Rhees Library  
Head, Documents Section  
Rever Campus Station  
Rochester, New York 14627

State University of New York at  
Binghamton  
Library - Documents Section  
Vestal Parkway East  
Binghamton, New York 13901

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New York University  
Washington Square  
New York, New York 10003

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Buffalo  
Lockwood Memorial Library  
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Buffalo, New York 14214

North Carolina

Duke University Library  
Public Documents Division  
Durham, North Carolina 27706

North Carolina State College  
D. H. Hill Library  
Raleigh, North Carolina 27607

University of North Carolina Library  
BA/SS Division - Documents  
Chapel Hill, North Carolina 27515

Ohio

Bowling Green State University Library  
Documents Department  
Bowling Green, Ohio 43402

Kent State University Library  
Documents Librarian  
Kent, Ohio 44240

Ohio University Library  
Documents Section  
Athens, Ohio 45701

Miami University Library  
Reference Department  
Oxford, Ohio 45056

Ohio State University Libraries  
Documents Division  
1858 Neil Avenue  
Columbus, Ohio 43210

Oberlin College Library  
Documents Librarian  
Reference Department  
Oberlin, Ohio 44074

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Librarian Technician - Documents  
University Library  
University of Akron  
Akron, Ohio 44304

Serials Librarian  
Wittenberg University Library  
Springfield, Ohio 45501

Serials Library  
Olive Kettering Library  
Antioch College  
Yellow Springs, Ohio 45387

Oklahoma

Oklahoma Department of Libraries  
109 State Capitol  
Oklahoma City, Oklahoma 73105

Central State College  
Max Chambers Library  
Documents Department  
Edmund, Oklahoma 73034

Oregon

Portland State University Library  
P. O. Box 1151  
ATTN: Serials  
Portland, Oregon 97207

Pennsylvania

Free Library of Philadelphia  
Department of Public Documents  
Philadelphia, Pennsylvania 19103

Carnegie Library of Pittsburgh  
Reference Department  
Pittsburgh, Pennsylvania 15213

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Hillman Library  
Documents Library, G8  
Pittsburgh, Pennsylvania 15213

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Pennsylvania State University Library  
Documents Librarian  
University Park, Pennsylvania 16802

Community College of Philadelphia  
Library  
34 South 11th Street  
Philadelphia, Pennsylvania 19103

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Brown University Library  
Documents Division  
Providence, Rhode Island 02912

University of Rhode Island Library  
Kingston, Rhode Island 02881

South Carolina

University of South Carolina  
Education Library  
Columbia, South Carolina 29208

Tennessee

University of Tennessee Library  
Documents Librarian  
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Joint University Libraries  
Serials and Documents  
Nashville, Tennessee 37203

Texas

Dallas Public Library  
Documents Librarian  
Dallas, Texas 75201

Acquisition Dept. Library  
North Texas State University  
Denton, Texas 76103

Texas (Continued)

Document Acquisition  
University of Texas Library  
Austin, Texas 78712

University of Texas  
at Arlington  
The Library  
Arlington, Texas 76010

Utah

University of Utah  
Library Periodical Room  
Salt Lake City, Utah 84112

Brigham Young University Library  
Documents Section  
Provo, Utah 84601

Utah State University Libraries  
Documents Division  
Logan, Utah 84321

Vermont

University of Vermont  
Documents Librarian  
Guy W. Bailey Library  
Burlington, Vermont 05401

Virginia

University of Virginia  
Alderman Library  
Public Documents  
Charlottesville, Virginia 22903

Washington

University of Washington Library  
Documents Librarian  
Seattle, Washington 98105

Washington State University Library  
Serial Record Section  
Pullman, Washington 99163

Washington State Library  
Library Building  
Olympia, Washington 98501

West Virginia

West Virginia University Library  
Reference Department  
Morgantown, West Virginia 26506

Wisconsin

Milwaukee Public Library  
Acquisition Division  
814 West Wisconsin Avenue  
Milwaukee, Wisconsin 53233

The Library  
University of Wisconsin-Milwaukee  
2500 E. Kenwood Boulevard  
Milwaukee, Wisconsin 53211

The Library  
Wisconsin State Library  
Stevens Point, Wisconsin 54481

Wyoming

University of Wyoming Library  
Documents Librarian  
Laramie, Wyoming 82071



## U. S. ARMY PERSONNEL PROGRAMS

utilizing psychological research test products of the  
Behavior and Systems Research Laboratory

PROGRAM	NUMBER OF APPLICANTS TESTED ANNUALLY
<u>Pre-enlistment Screening of Male Enlistment Applicants</u>  To screen men enlisting or reenlisting from civilian life who must be tested prior to traveling to Armed Forces Examining Stations for Armed Forces Qualification Test (AFQT) administration.  <u>Tests:</u> Enlistment Screening Test, EST.	468,000
<u>Screening of Male Enlistment Applicants</u>  To screen men on mental acceptability prior to enlistment at AFEES.  <u>Tests:</u> Armed Forces Qualification Test, AFQT. Army Qualification Battery, AQB.	430,000 378,400
<u>Pre-enlistment Screening of Female Enlistment Applicants</u>  To screen women enlisting or reenlisting from civilian life who must be tested prior to traveling to Armed Forces Examining Stations for Armed Forces Women's Selection Test (AFWST) administration.  <u>Tests:</u> Women's Enlistment Screening Test, WEST.	9,000
<u>Screening of Female Enlistment Applicants</u>  To screen women for mental acceptability prior to enlistment.  <u>Tests:</u> Armed Forces Women's Selection Test, AFWST. Women's Army Classification Battery, WACB.	7,100
<u>Screening and Counseling of Male High School Seniors</u>  To screen high school seniors and provide guidance regarding their aptitude potential for Army jobs.  <u>Test:</u> Armed Services Vocational Aptitude Battery	371,388

PROGRAM	NUMBER OF APPLICANTS TESTED ANNUALLY
<u>Enlistment Screening of Male Reserve and National Guard Applicants</u>  To screen men for mental acceptability prior to enlistment in the Army Reserve or the Army National Guard.  <u>Tests:</u> Armed Forces Qualification Test, AFQT (Reserve Components Edition). Army Qualification Battery, AQB (Reserve Components Edition).	177,000
<u>Screening of Selective Service Registrants</u>  To screen Selective Service Registrants for mental acceptability prior to induction.  <u>Tests:</u> Armed Forces Qualification Test, AFQT. Army Qualification Battery, AQB.	1,361,000 227,000
<u>Detecting Deliberate AFQT Failures</u>  To aid personnel psychologist in verifying AFQT failures among Selective Service Registrants with percentile scores of 0 through 9 on AFQT.  <u>Tests:</u> Included within Terminal Screening Procedures	122,000
<u>Screening of Insular Puerto Rican Selective Service Registrants</u>  To screen Selective Service Registrants in Puerto Rico who must undergo mental acceptability testing in Spanish prior to induction into the Army for training.  <u>Tests:</u> Examen Calificación de Fuerzas Armadas, ECFA. English Fluency Battery, EFB. Army Classification Battery, ACB.	24,000
<u>Initial Classification of Enlisted Male Personnel</u>  To determine MOS appropriate for direct award, and MOS recommended for advanced training of replacement stream enlisted personnel processed through Reception Stations.  <u>Tests:</u> Army Classification Battery, ACB. (Standard Scores on 11 tests are converted into 8 Aptitude Area composites.	400,000

PROGRAM	NUMBER OF APPLICANTS TESTED ANNUALLY
<p><u>Initial Classification of Motor Vehicle Drivers</u></p> <p>To screen individuals during Reception Station processing as a prerequisite to licensing for driver assignments.</p> <p><u>Tests:</u> Motor Vehicle Driver Selection Battery I, MDB-I</p>	370,250
<p><u>Selection of Basic Trainees for Training as Acting NCOs</u></p> <p>To select basic trainees for training as acting NCOs. Selection is based on peer ratings of leadership potential obtained during the fifth week of Basic Combat Training. Individuals selected are given two weeks of NCO training upon completion of their Basic Combat Training, and serve as acting NCOs during Advanced Individual Training.</p> <p><u>Tests:</u> Leadership Potential Rating, LPR. (This procedure consists of a ranking procedure within training squads, followed by a rating of leadership potential on a seven-point scale.)</p>	370,250
<p><u>Licensing Drivers of Army Motor Vehicles</u></p> <p>To determine qualifications of military personnel, civilians, and indigenous personnel for standard driver licenses.</p> <p><u>Tests:</u> Motor Vehicle Driver Selection Battery II, MDB-II (unless previously qualified on MDB-I). Testing Procedures for Licensing Drivers of Army Motor Vehicles: Includes physical evaluation and driving performance test.</p>	170,000
<p><u>Selection of Personnel for Foreign Language Training</u></p> <p>To screen personnel for foreign language aptitude as a prerequisite for application for training at the Army Language School.</p> <p><u>Tests:</u> Defense Language Aptitude Test, DLAT</p>	175,000

PROGRAM	NUMBER OF APPLICANTS TESTED ANNUALLY
<p><u>Measurement of Foreign Language Proficiency</u></p> <p>To determine the extent to which military personnel meet qualifying standards of proficiency in specified foreign languages.</p> <p><u>Tests:</u> DOD Language Proficiency Tests in the following languages: Albanian, Arabic-Egyptian, Arabic-Iraqi, Arabic-Syrian, Bulgarian, Burmese, Chinese Cantonese, Chinese Mandarin, Czech, Danish, Dutch, Finnish, French, German, Greek, Hebrew, Hungarian, Icelandic, Indonesian, Italian, Japanese, Korean, Lithuanian, Norwegian, Persian, Polish, Portuguese, Portuguese-Brazilian, Romanian, Russian, Serbo-Croatian, Slovenian, Spanish-Latin American, Spanish-European, Swahili, Thai, Turkish, Ukrainian, Vietnamese-Hanoi, Vietnamese-Saigon, Yiddish.</p>	61,000
<p><u>Measurement of Skill in Shorthand and Typing</u></p> <p>To obtain typing and dictation scores for those enlisted personnel undergoing reception station processing who claim skill in typing and shorthand. Scores obtained are used in determining the individual's most appropriate training and assignment.</p> <p><u>Tests:</u> Typing and Dictation Test.</p>	Data not available
<p><u>Selection for Training and Assignment in Special Forces Organizations</u></p> <p>To determine the aptitude of enlisted volunteers in the Active Army and in the Army Reserve for training and assignment in Special Forces organizations.</p> <p><u>Tests:</u> Special Forces Selection Battery, consisting of:</p> <ol style="list-style-type: none"> <li>Special Forces Locations Test, SFL.</li> <li>Critical Decisions Test, CDT.</li> <li>Special Forces Suitability Inventory, SFI.</li> </ol>	10,500

PROGRAM	NUMBER OF APPLICANTS TESTED ANNUALLY
<p><u>Selection of Personnel for Training as Army Aviators</u></p> <p>To screen male personnel who volunteer for fixed-wing or rotary-wing aviator training courses.</p> <p><u>Tests:</u> 1. For administration to officers applying for officer aviator courses. Flight Aptitude Selection Tests, FAST</p> <p>2. For administration to enlisted men and enlistment option applicants volunteering for Warrant Officer Candidate aviation courses. Flight Aptitude Selection Tests, FAST.</p>	<p>3,500</p> <p>11,000</p>
<p><u>Selection of ROTC Cadets for Fixed-Wing Aviation Training</u></p> <p>To select ROTC Cadets for fixed-wing aviation flight training.</p> <p><u>Tests:</u> Army Fixed-Wing Aptitude Battery</p>	<p>2,000</p>
<p><u>Selection of Cadets for Junior College ROTC Training</u></p> <p>To select students at Military Schools Division Army ROTC units established at secondary level and junior college educational institutions for MST-5 and MST-6 ROTC training.</p> <p><u>Tests:</u> General Screening Test, GST. (Testing occurs during senior high school year.)</p>	<p>900</p>
<p><u>Selection of Cadets for Senior Division Advanced ROTC Training</u></p> <p>To select cadets for Senior Division Advanced ROTC training from among students who are successfully completing or receiving credit for basic course (first two years college).</p> <p><u>Tests:</u> ROTC Qualifying Examination, RQ. (Testing occurs during sophomore college year.)</p>	<p>30,000</p>
<p><u>Selection of Male Officer Personnel for Training as Army Image Interpreters</u></p> <p>To determine qualifications of Army Intelligence and Security Branch (AIS) officers for training as Army image interpreters.</p> <p><u>Tests:</u> Image Interpreter Selection Battery consisting of:</p> <p>a. Image Orientation Test</p> <p>b. Image Interpreter Information Test</p>	<p>3,000</p>

PROGRAM	NUMBER OF APPLICANTS TESTED ANNUALLY
<p><u>Selection of Male Personnel for Officer Candidate School</u></p> <p>To screen Warrant Officers and enlisted men in the Active Army and in the Army Reserve not on active duty who are applying for Officer Candidate School. Minimum scores on Aptitude Area GT and Officer Candidate Test, OCT are required as a prerequisite to administration of the Officer Candidate Selection Battery to Active Army applicants.</p> <p><u>Tests:</u> Officer Candidate Selection Battery, consisting of:</p> <ul style="list-style-type: none"> <li>a. Officer Leadership Qualification Report, OLR-1.</li> <li>b. Officer Qualification Inventory, OQI-1.</li> <li>c. Officer Leadership Board Interview, OLB-1.</li> </ul>	<p>145,000</p> <p>48,000</p>
<p><u>Selection of Female Personnel for Officer Candidate School</u></p> <p>To screen Warrant Officers and enlisted women in the Active Army and in the Army Reserve not on active duty who are applying for Officer Candidate School.</p> <p><u>Tests:</u> WAC Officer Candidate Selection Battery, consisting of:</p> <ul style="list-style-type: none"> <li>a. WAC OCS Biographical Information Blank.</li> <li>b. WAC Officer Candidate Applicant Interview.</li> <li>c. WAC Officer Candidate Applicant Evaluation Report. (Minimum score on Aptitude Area GT required as a prerequisite to administration of the WAC Officer Candidate Selection Battery to Active Army applicants.)</li> </ul>	<p>125</p>

PROGRAM	NUMBER OF APPLICANTS TESTED ANNUALLY
<p><u>Appointment of Male Personnel as Reserve Warrant Officers</u></p> <p>To select enlisted men in the Active Army and in the Army Reserve not on active duty for appointment as Reserve Warrant Officers.</p> <p><u>Tests:</u> 1. For administration to enlisted men in the Active Army (except aviation):</p> <ul style="list-style-type: none"> <li>a. Officer Qualification Inventory, OQI-1.</li> <li>b. Officer Leadership Board Interview, OLB</li> <li>c. Officer Leadership Qualification Report, OLR</li> </ul> <p>2. For administration to enlisted men not on active duty (except aviation):</p> <ul style="list-style-type: none"> <li>a. Officer Qualification Inventory, OQI-1.</li> <li>b. Officer Leadership Board Interview, OLB</li> <li>c. Interview Appraisal Sheet S</li> </ul>	5,500
<p><u>Appointment of Female Personnel as Reserve Warrant Officers</u></p> <p>To select enlisted women in the Active Army and in the Army Reserve not on active duty for appointment as Reserve Warrant Officers.</p> <p><u>Tests:</u> WAC OCS Biographical Information Blank. WAC Officer Candidate Applicant Officer Interview. Interview Appraisal Sheet S.</p>	10
<p><u>Appointment of Male Personnel to Commissions in the United States Army Reserve</u></p> <p>To select male personnel in the following categories for appointment to commissions in the United States Army Reserve: Warrant Officers and enlisted men currently serving in any component of the Army; Reserve Warrant Officers and enlisted men who are currently serving in an active status in the Army Reserve; and former warrant officers and enlisted men.</p> <p><u>Tests:</u> Officer Qualification Inventory, OQI-1. Officer Leadership Board Interview, OLB. Interview Appraisal Sheet M (for use with all applicants except technical experts or specialists) or Interview Appraisal Sheet S (for use with technical experts or specialists).</p>	8,500

PROGRAM	NUMBER OF APPLICANTS TESTED ANNUALLY
<p><u>Appointment of WAC Personnel to Commissions in the United States Army Reserve</u></p> <p>To select female personnel in the following categories for appointment to commissions in the United States Army Reserve: Warrant Officers and enlisted women currently serving in any component of the Army; Reserve Warrant Officers and enlisted women who are currently serving in an active status in the Army Reserve, and former warrant officers and enlisted women.</p> <p><u>Tests:</u> WAC OCS Biographical Information Blank. WAC Officer Candidate Applicant Interview. Interview Appraisal Sheet M (for use with all applicants except technical experts or specialists) or Interview Appraisal Sheet S (for use with technical experts or specialists).</p>	650
<p><u>Appointment of Male Personnel to Commissions in the Regular Army</u></p> <p>To select male personnel in the categories indicated below for appointment to commissions in the Regular Army.</p> <p><u>Tests:</u> 1. For administration to officers on active duty, to former commissioned officers, and to applicants for commissions in Corps of the Army Medical Service: a. Interview Blank, Form 4. b. Biographical Information Blank, Form F.</p> <p>2. For administration to Warrant Officers and enlisted men on active duty and to former Warrant Officers and enlisted men: a. Officer Qualification Inventory, OQI-1. b. Officer Leadership Board Interview, OLB. c. Officer Leadership Qualification Report, OLR.</p> <p>3. For administration to ROTC Distinguished Military Graduates: a. ROTC Inventory, RI. b. ROTC Evaluation Report, ROE-2.</p>	



PROGRAM	NUMBER OF APPLICANTS TESTED ANNUALLY
<u>Appointment of Male Personnel to Commissions in the Regular Army (Continued)</u> <ol style="list-style-type: none"> <li>4. For administration to technical specialists possessing advanced degrees or possessing bachelor's degree with appropriate experience: <ol style="list-style-type: none"> <li>a. Interview Blank, Form 4.</li> <li>b. Biographical Information Blank, Form F.</li> <li>c. Interview Appraisal Sheet S.</li> </ol> </li> <li>5. For administration to scholastically outstanding graduates of accredited colleges and universities who did not take ROTC training for valid reasons: <ol style="list-style-type: none"> <li>a. ROTC Inventory, RI</li> <li>b. Officer Leadership Board Interview, OLB.</li> </ol> </li> </ol>	6,200
<u>Appointment of Female Personnel to Commissions in the Regular Army</u> <p>♦ To select female personnel in the categories indicated below for appointment to commissions in the Regular Army.</p> <p><u>Tests:</u></p> <ol style="list-style-type: none"> <li>1. For administration to warrant officers and enlisted women on active duty and to former warrant officers and enlisted women: <ol style="list-style-type: none"> <li>a. WAC Officer Candidate Applicant Interview.</li> <li>b. WAC Officer Candidate Applicant Evaluation Report.</li> <li>c. WAC OCS Biographical Information Blank.</li> </ol> </li> <li>2. For administration to applicants for Regular Army commissions in the Army Nurse Corps, the Women's Medical Specialist Corps, and the Medical Corps: <ol style="list-style-type: none"> <li>a. Board Interview for Officers in the Army Medical Service.</li> <li>b. Biographical Information Blank for Women Officers in the Army Medical Service, BI3-AMS.</li> </ol> </li> </ol>	50

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*Manpower management						
*Human performance experimentation						
*Manned system research						
Computerized manpower systems						
*Selection--military personnel						
*Classification--military						
*Evaluation--human performance						
Simulation studies						
*Evaluation--systems effectiveness						
*Manpower utilization						
Mathematical manpower models						
Statistical analysis						
*Psychometrics						
Differential classification						
Image interpretation						
Intelligence systems						
Command systems						
Decision making						
Research design						
Performance prediction						
Monitor performance						
Measurement techniques						
Military psychology						
*Behavior and systems research						